All plots should be done by hand, not by computer (a calculator, if needed, is OK).

1) Consider the continuous signals \( x(s) = \max(\sin(2\pi s), 0) \) and \( y(s) = \min(\sin(2\pi s), 0) \)

where \( \max(a, b) = \begin{cases} a & a \geq b \\ b & a < b \end{cases} \) and \( \min(a, b) = \begin{cases} b & a \geq b \\ a & a < b \end{cases} \).

a) Is \( x(s) \) periodic? If so, compute the fundamental period.

b) Is \( y(s) \) periodic? If so, compute the fundamental period.

c) Consider the signal \((x(s) - y(s))\). Is it periodic? If so, compute the fundamental period, and reconcile your answer with the answers to (a) and (b).

2) Consider the discrete signals \( x[n] = \begin{cases} 0 & \text{for } n \text{ even} \\ 1 & \text{for } n \text{ odd} \end{cases} \) and \( y[n] = \sin(n) \).

a) Is \( x[n] \) periodic? If so, compute the fundamental period.

b) Is \( y[n] \) periodic? If so, compute the fundamental period.

3) For each of the following continuous signals \( x(t) \), compute, \( \text{Ev}\{x(t)\} \) i.e. the even part of \( x(t) \), and \( \text{Od}\{x(t)\} \), i.e. the odd part of \( x(t) \).

a) \( x(t) = Ce^{j\omega_o t} \), where \( C = e^{j\pi/2} \).

b) \( x(t) = \frac{1}{1 + 2t} \).

c) \( x(t) = 2 \).

4) Consider the continuous signal \( x(t) = Ce^{j\omega_o t} \)

a) For \( C = \frac{1 + j}{\sqrt{2}} = e^{j\pi/4} \), \( \omega_o = \frac{4}{5} \pi \), on separate graphs, plot \( \text{Re}(x(t)) \) and \( \text{Im}(x(t)) \) in the range \([-3, +3]\), and compute the fundamental period of \( x(t) \).

b) For \( C = 1.5 \text{Volts}, \omega_o = 2\pi f_0, f_0 = 2 \text{kHz} \), on separate graphs, plot \( \text{Re}(x(t)) \) and \( \text{Im}(x(t)) \) in the range \([-1 \text{ms}, +1 \text{ms}]\), and compute the fundamental period of \( x(t) \) (with the correct units).

5) Consider the continuous signal \( x(t) = Ce^{\alpha t} \), where \( C = \sqrt{2} \left(1 + j\right) = 2e^{j\pi/4}, \alpha = 1 + 2\pi j \).

a) Plot \(|x(t)|\) and \(-|x(t)|\) and \(\text{Re}(x(t))\), on the same graph, in the range \([-2, +2]\).
b) Plot \(|x(t)|\) and \(-|x(t)|\) and \(\text{Im}(x(t))\), on the same graph, in the range \([-2, +2]\).

6) Consider the discrete signal: \(x[n] = C\alpha^n\).
   a) Plot \(x[n]\) in the range \([-2, +2]\), for \(C = 3, \alpha = 2\).
   b) Plot \(x[n]\) in the range \([-2, +2]\), for \(C = 3, \alpha = 2^{-1}\).
   c) Plot \(x[n]\) in the range \([-2, +2]\), for \(C = 3, \alpha = -2\).
   d) Plot \(x[n]\) in the range \([-2, +2]\), for \(C = -3, \alpha = 2\).

7) Consider a discrete signal \(x[n] = Ce^{j\omega_0 n}\) which is periodic with \(N = 6\).
   a) List the allowed values of \(\omega_0\) in the range \([0, 2\pi]\).
   b) List the allowed values of \(\omega_0\) in the range \([-\pi, +\pi]\).

8) Consider the following systems, where \(x \rightarrow \text{[System]} \rightarrow y\)
   a) \(y(t) = \cosh(x(t)) = \frac{1}{2}(e^{x(t)} + e^{-x(t)})\)
   b) \(y[n] = \text{Run}_{\rightarrow}(x[n]) = \sum_{n=\rightarrow}^{n} x[n']\)
   c) \(y[n] = |x[n+1] - x[n]|\)
   d) \(\frac{d}{dt}y(t) + \omega y(t) = \omega^2 tx(t)\)
   i) Which of the systems (a-c) are instantaneous/ultralocal/memoryless?
   ii) Which of the systems (a-d) are invertible?
   iii) Which of the systems (a-c) are causal?

   iv) In a few words and/or equations, explain why system (a) is or isn’t instantaneous/ultralocal/memoryless
   v) In a few words and/or equations, explain why system (b) is or isn’t instantaneous/ultralocal/memoryless
   vi) In a few words and/or equations, explain why system (a) is or isn’t instantaneous/ultralocal/memoryless
   vii) In a few words and/or equations, explain why system (b) is or isn’t instantaneous/ultralocal/memoryless
   viii) In a few words and/or equations, explain why system (a) is or isn’t invertible
   ix) In a few words and/or equations, explain why system (b) is or isn’t invertible
   x) In a few words and/or equations, explain why system (c) is or isn’t invertible
   xi) In a few words and/or equations, explain why system (d) is or isn’t invertible
   xii) In a few words and/or equations, explain why system (b) is or isn’t causal
   xiii) In a few words and/or equations, explain why system (c) is or isn’t causal